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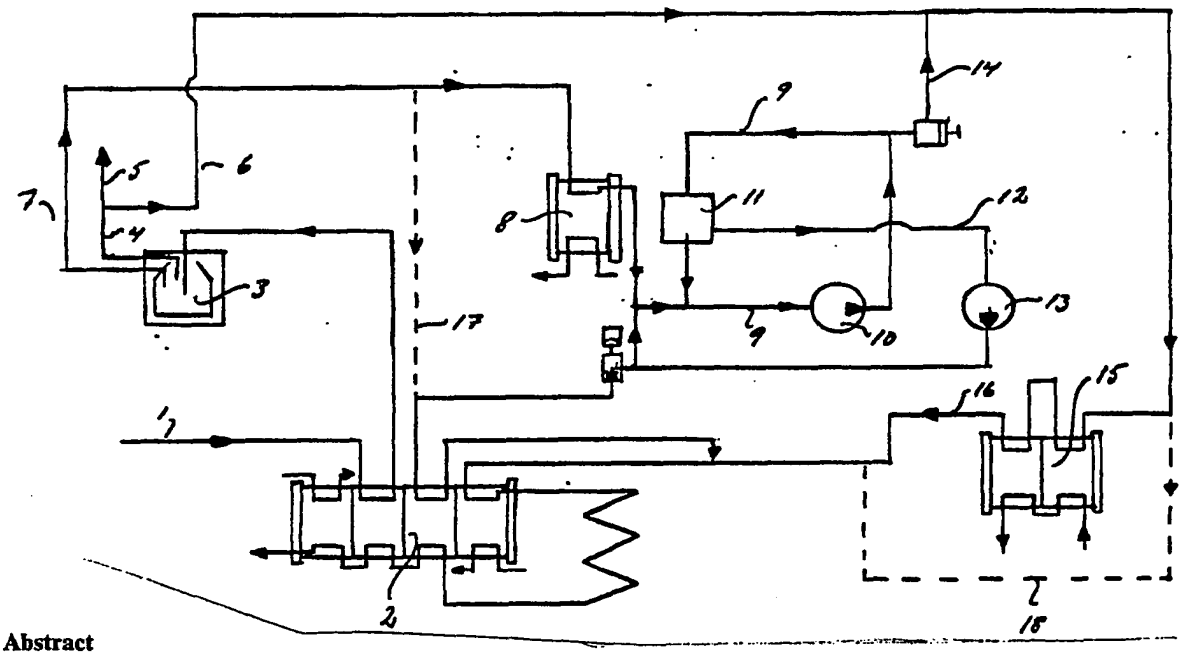
(54) Title: METHOD AND PLANT FOR PRODUCING MILK WITH A LOW BACTERIAL CONTENT



(57) Abstract

Whole milk is divided by centrifugal separation into one fraction consisting of cream and one fraction consisting of skim milk. The skim milk fraction is brought to pass a microfilter in which fat globules and bacteria are separated off. From the microfilter there is obtained a permeate which consists of skim milk with a low bacterial content and a concentrate with a higher fat content than the permeate, which concentrate is sterilized.

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Method and plant for producing milk with a low bacterial content

The present invention relates to a method and a plant for producing milk with a low bacterial content, at which whole milk by centrifugal separation is divided into a fraction consisting of cream and a fraction consisting of skim milk. The cream fraction may depending on the desired end product be handled in different ways.

It is known earlier to produce milk with a low bacterial content by removing the bacteria. In the Swedish patent publication 208 841 there is described a method of treating bacteria containing milk by bactofuge treatment of the milk. The liquid enriched in bacteria is sterilized by heating and is remixed with the centrifuged milk. By this treatment about 90 % of the bacteria may be removed.

Through the Swedish patent publication 380 422 it is known to divide whole milk into two fractions by microfiltration by bringing the milk to flow along the surface of the filter. The permeate which passes the pores of the filter (size of the pores 0.1 - 10 µm) consists of skim milk, while the concentrate consists of cream. Since the fat globules and the bacteria in the milk are of about the same size, the skim milk obtained is practically free from bacteria. This method of treating the milk is certainly effective, but the filtration step is expensive and power demanding.

In certain connections it is of special importance to obtain a milk with a low bacterial content. The raw milk may be so contaminated that merely pasteurizing does not give adequate keeping qualities. For certain applications it may be of value t b able t offer milk where the bacteria content has been reduced t about ne hundredth of the original value. It is

especially important to be able to start with a milk with a low bacterial content when producing cheese, since incorrect bacteria cultures may destroy the produced cheeses. It is not suitable to heat-treat the milk in a sufficient degree, since the heat treatment may give a lower yield of cheese and influence the coagulation time.

Today one usually adds salpetre in order to avoid incorrect fermentations. In many connections it would be desirable to avoid this addition.

According to the invention a new method of treating whole milk is suggested according to which a considerable reduction of the bacterial content of the treated milk is obtained, without having to pay the large costs which are connected to filtration of whole milk. The invention relates to a combination of centrifugal separation and microfiltration.

According to the method of the invention merely the skim milk fraction obtained at the centrifugal separation is brought to pass a microfilter, in which bacteria and remaining fat globules are separated off. At that a permeate is obtained which consists of skim milk with a low bacterial content and a concentrate with a higher fat content than the permeate, which concentrate is sterilized. The concentrated permeate and cream fraction are remixed in desired relations.

This method of producing milk with a low bacterial content may be used either the end products consists of whole milk, standardized milk, or skim milk. If the permeate consisting of treated skim milk is mixed with the sterilized concentrate, or a part thereof, the end product consists of skim milk. If the whole or parts of the cream fraction are brought back and mixed with the skim milk, whole milk or standardized milk is obtained. The method functions also if a small part of the cream is remixed with the skim milk pri r to the micr filtration, but the capacity of the microfilter diminishes rapidly with an increasing fat content in the milk.

In the milk treating steps after the microfiltration homogenization and heat treatment adapted to the use of the milk are included.

The skim milk is with advantage brought to pass a circulation path containing the microfilter, at which the skim milk is brought to flow in parallel with the surface of the membrane during the microfiltration (cross flow filtration). In order to obtain a sufficient flow through the membrane of the microfilter the skim milk must pass the surface of the membrane with a high speed. A suitable size of the pores of the membrane in the microfilter is 0.1 - 1.2 μm.

The optimal temperature during the filtration is 50 - 60°C and depending on the temperature of the milk after the centrifugal separation it is heated or cooled to the suitable temperature interval for the microfiltration prior to supplying to the circulation path.

In addition there will be a certain heating depending on the work of the pump during operation and the heating/cooling is adapted to this.

Studies of the clogging of the filter have shown that an advantageous method of carrying through the filtration is to start with a milk temperature of the circulating milk of about 50°C at the beginning of each working period and then let the temperature slowly rise to 60°C. The filters must be cleaned after some hours operation, normally 5 - 8 h. The highest capacity but also the fastest clogging is obtained when microfiltration takes place at about 60°C.

A plant for producing milk with a low bacterial content consists of a heat exchanger for heating whole milk to a suitable separation temperature and a centrifugal separator for purifying and dividing the whole milk into one fraction consisting of

cream and one fraction consisting of skim milk. The plant is especially characterized in that it also comprises a microfilter connected to a pipe line for skim milk, in which microfilter there is obtained a division of the skim milk into a permeate with a low bacterial content and a concentrate with a higher fat content. The concentrate contains bacteria separated in the microfilter and a sterilizator is connected to the concentrate pipe.

The microfilter is with advantage arranged in a first circulation path comprising a first pump in order to obtain a sufficient flow of skim milk passing along the membrane surfaces in the microfilter.

Apart from this first circulation path the plant with advantage comprises a second circulation path comprising a second pump to bring back permeate from the microfilter to the inlet of the first circulation path. By bringing back smaller or larger amounts of permeate which passes the microfilter again, it is possible to compensate for the variations in flow resistance which exist between start and steady state for the flow through the microfilter.

The capacity of a pasteurizing plant is constant, while the capacity of the microfilter is very large at the start of the working period but falls rapidly thereafter. When the capacity of the microfilter falls below that of the pasteurization plant, the plant must be stopped. The bringing back of permeate described above involves a solution of the problem of using an apparatus with a variable capacity in a plant intended for continuous treatment of a determined amount of skim milk adapted to the capacity of the centrifugal separator.

The plant is with advantage provided with a heat exchanger

connected between the centrifugal separator and the circulation path in order to ensure a suitable temperature of the skim milk for microfiltration.

According to the invention the plant is advantageously provided with separate circuits with temperature and cleaning programmes adapted to the respective unit. In both these units there are special problems with the cleaning. In the microfilter it may be hard to clean the surface of the membrane from the coating of milk proteins which spontaneously is formed when the milk passes a membrane. In the sterilization unit it is the high temperatures that may lead to incrustations.

The plant according to the invention may also be arranged such that the microfilter and the sterilization unit may be connected off from the process circuit and the plant my be operated as an ordinary pasteurization plant. With such an arrangement it is possible to adapt the plant easily to occasional changes in the production, as for example an error in the microfilter or the sterilization unit or in some of the pasteurization plants within the dairy.

The invention is described further with reference to the attached flow chart which shows production of standardized milk with a low bacterial content.

Whole milk 1 from cooled storage tanks in the dairy is heated to a suitable separation temperature in a plate heat exchanger 2 and is thereafter led to a centrifugal separator 3, where it is divided into two fractions. One section 4 consists of cream, which is divided into two part streams 5 and 6. The part stream 5 is led away and consists of end product. From the centrifugal separator there is also obtained a second fraction, skim milk, 7. This is brought to pass a heat exchanger 8 in rder to be cooled/heated to a suitable temperature. After this adaption

of the temperature, the skim milk is led to a circulati n path 9 comprising a pump 10 and a microfilter 11. The microfilter consists of a number of membranes arranged in parallel to each other, over which the skim milk is brought to pass in parallel with the surface of the membrane. The membrane consists of some material which is allowed for food use. It is of course also possible to use a microfilter of a the type of a filter tube within a shell or some other kind of arranging the membranes.

The circuit 12 constitutes together with a second pump 13 a second circulation path which makes it possible to bring back permeate to the skim milk fraction after passage of the heat exchanger 8. From the microfilter 11 a permeate flow is taken away by way of a pipe 12 which permeate flow consists of skim milk with a low bacterial content. Permeate is brought to pass the heat exchanger 2 to have its temperature adapted. The concentrate 14 obtained at the microfiltration which concentrate contains fat globules and bacteria is connected to the part stream 6 of cream and led to a sterilization plant 15. The sterilized cream 16 and the heated skim milk are mixed with milk with a predetermined fat content and led to the heat exchanger 2 in order to be subjected to a finishing heat treatment step. This may depending on the intended application for the obtained milk be either a pasteurizing treatment or, if the milk is to be used for the producing of cheese, a more mild heat treatment.

In the plant there is also a number of valves not described for controlling the flow and/or pressure of the different fractions which are handled in the same.

In the drawing there is seen that the plant has been designed such that the skim milk fraction is led directly to the heat exchanger 2 by way of the pipe 17. The cream fraction 6 may pass the sterilization unit 14 through the pipe 18. Being able t use the plant as a usual pasteurization plant may be of

advantage, both if some error arises on the microfilter or on the sterilization unit, and also if an unexpected large demand arises of milk which only needs pasteurizing. If homogenization of the milk is desired, this takes suitably place immediately prior to the pasteurizing. The plant is also provided with separate cleaning circuits for the microfilter and the sterilizing unit which are not shown in the drawing. The cleaning of the microfilter takes suitably place in such a way that the surfaces of the membrane are rinsed at first, after which a strongly alkalic detergent is flushed over the surface of the membrane and may work disolvingly during some hours and first thereafter it is rinsed away with water. With such a treatment a good cleaning of the surfaces of the membrane is obtained also from substances which are difficult to dissolve an also a chemical influence of the membrane which improves coming filtration. This cleaning has also a good bacteriostatic effect.

The example given below shows how the method according to the invention may be used for producing standardized milk with a low bacterial content.

Example

10.000 l/h whole milk with 4 % fat content is heated to a separation temperature of 52°C and led to a centrifugal separator from which is taken 1.000 l/h cream with a fat content of 40 %. Of these 1.000 l/h 250 l/h is taken away and constitutes the end product, while 750 l/h is used for remixing. From the centrifugal separator there is also obtained 9.000 l/h skim milk with a fat content of 0.06 %. In the second circulation path a flow is maintained with the help of the pump 13 which may vary from 8.000 l/h to 16.000 l/h. From the second circulation path there is taken 8.100 l/h permeate with a fat content of 0.04 %, whil from the first circulation

path 900 l/h concentrate with a fat content of 0.25 % is continuously taken away. The concentrate is mixed with the part stream of cream of 750 l/h and gives 1.650 l/h cream mixture with a fat content of 18 %, which is sterilized. After the sterilization the cream mixture is mixed with the purified skim milk and the end product constitutes 9.750 l/h standardized milk with a fat content of 3 %.

Claims

1. Method for producing milk with a low bacterial content at which whole milk by centrifugal separation is purified and divided into a fraction consisting of cream and a fraction consisting of skim milk, characterized in that the skim milk fraction is brought to pass a microfilter in which fat globules and bacteria are separated off, at which is obtained a permeate which consists of skim milk with a low bacterial content and a concentrate with a higher fat content than the permeate, which concentrate is sterilized and in that concentrate, permeate and cream fraction are remixed in desired relations.

2. Method according to claim 1, characterized in that the concentrate or a part of it is remixed with the permeate.

3. Method according to claim 1, characterized in that the concentrate is mixed with a part of the cream fraction, is sterilized and thereafter mixed with the permeate.

4. Method according to claim 1, characterized in that the microfiltration takes place by bringing the skim milk to pass a circulation path comprising the microfilter, at which the skim milk is brought to flow in parallel with the surface of the membrane during the microfiltration (cross-flow filtration).

5. Method according to claim 4, characterized in that the pore size in the membrane is 0.2 - 1.0 µm.

6. Method according to claim 1, characterized in that the skim milk prior to the microfiltration is brought t pass a heat exchanger to assume a temperature which is

suitable for entering the circulation path.

7. Method according to claim 6, characterized in that the microfiltration is carried through at a temperature within the temperature field 50-60°C.

8. Method according to claim 7, characterized in that the temperature of the skim milk which circulates at the start of each operation period is kept at a given temperature near 50°C, after which the temperature may arise against 60°C, at which there is obtained a maximum use of the capacity of the filter.

9. Plant for producing milk with a low bacterial content comprising a heat exchanger (2) for heating whole milk to a suitable separation temperature, a centrifugal separator (3) for purifying and dividing of the whole milk into one fraction consisting of cream and one fraction consisting of skim milk, characterized in that it also comprises a microfilter (11) arranged in connection to a pipeline for skim milk, in which microfilter (11) there is obtained a division of the skim milk into a permeate with a low bacterial content and a concentrate with a higher fat content comprising bacteria separated off in the microfilter and a sterilization unit (15) connected to a concentrate pipe.

10. Plant according to claim 9, characterized in that the microfilter (11) is arranged in a first circulation path comprising a first pump (10) in order to obtain a sufficient flow for the skim milk when passing along the membrane surfaces in the microfilter (11).

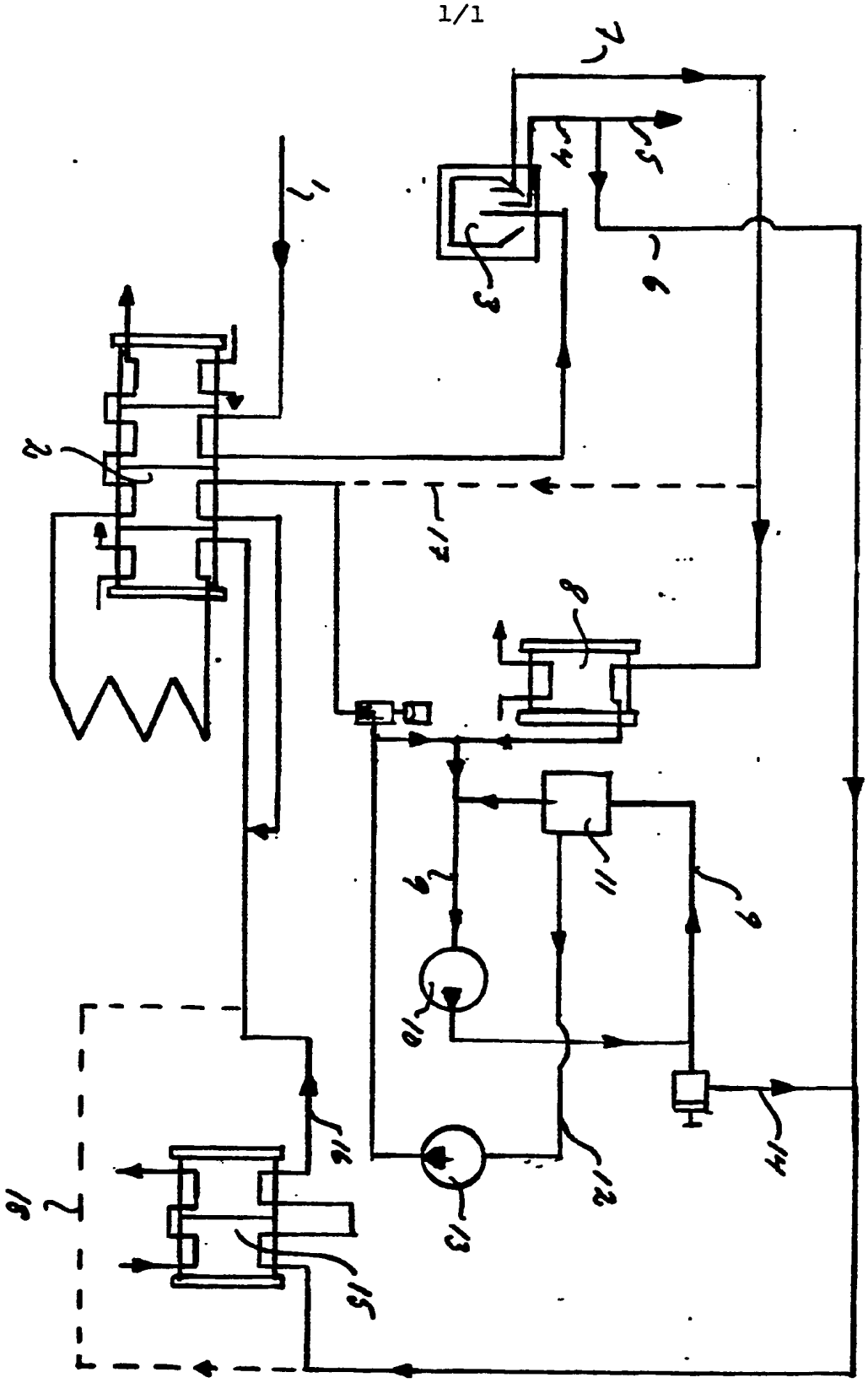
11. Plant according to claim 9-10, characterized in that it comprises a second circulation path apart from the first circulation path which second path comprises a sec nd pump

(13) to bring back permeate, skim milk, from the microfilter to the inlet of the first circulation path.

12. Plant according to claim 9-10, c h a r a c t e r i z e d i n that it comprises a heat exchanger (8) connected between the centrifugal separator (3) and a circulation path in order to ensure a suitable temperature of the skim milk prior to entering these paths.

13. Plant according to any of the preceding claims, c h a r a c t e r i z e d i n that both the microfilter (11) and the sterilizing unit (15) are provided with separate cleaning paths with temperature and cleaning programmes adapted to the respective unit.

14. Plant according to any of the preceding claims, c h a r a c t e r i z e d i n that it is arranged such that the microfilter (11) and the sterilizing unit (15) may be connected off from the process path and the plant may be run in the same way as an ordinary pasteurizing plant.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INTERNATIONAL SEARCH REPORT

International Application No PCT/SE85/00325

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC 4

A 23 C 3/00, A 01 J 11/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC 4	A 23 C 3/00, 9/00, /14, /142, /148; A 01 J 11/00
IPC 2	A 23 C 9/10
US Cl	426:330, 330.2, 491, 522

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X,Y	SE, A, 6 715 081 (AB TETRA PAK) 4 May 1969 see claim 1	1-14
Y	EP, A1, 0 052 862 (COMPAGNIE GENERALE D'ELECTRICITE) 2 June 1982 see page 1, lines 24-25 and fig 1 & FR, 2494586	1-14
Y	US, A, 4 140 806 (ALFA-LAVAL AB) 20 February 1979 see column 1, lines 54-55, column 2, lines 1-2 and fig 1, 2	1-14
Y	DE, A, 739 170 (SIEMENS-SCHUCKERTWERKE AG) 5 August 1943 see claim 1 and fig 4	1-14

* Special categories of cited documents: [10]

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IV. CERTIFICATION

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